OVERVIEW OF SEAL DEVELOPMENT AT ALBANY-TECHNIWEAVE

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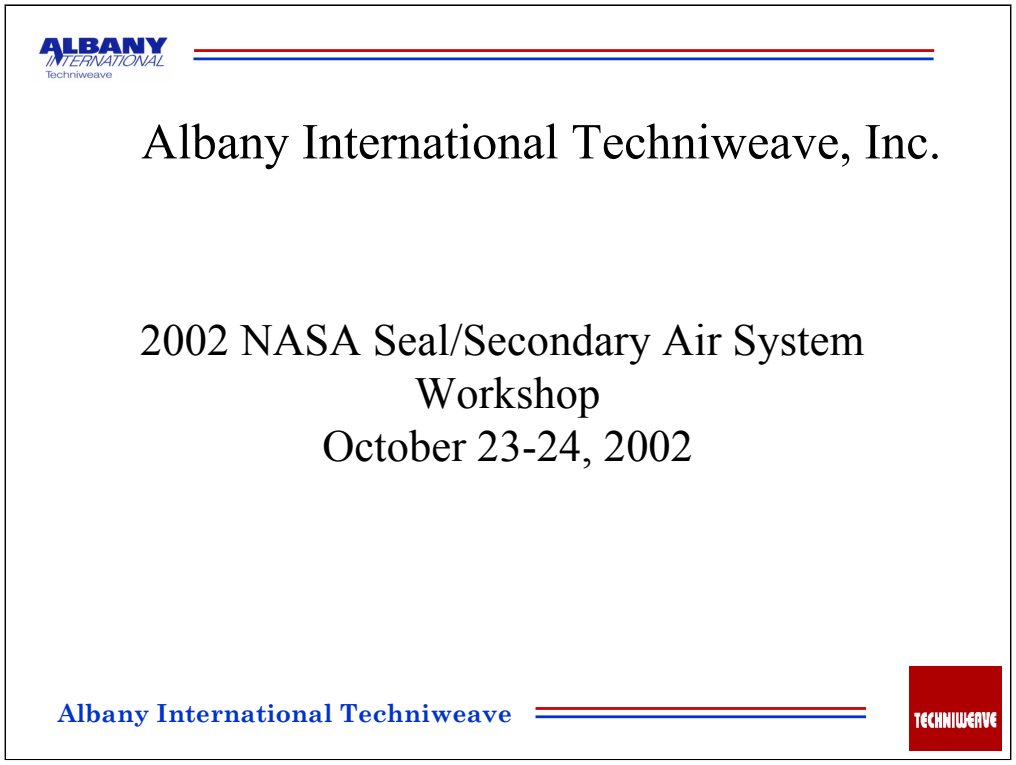

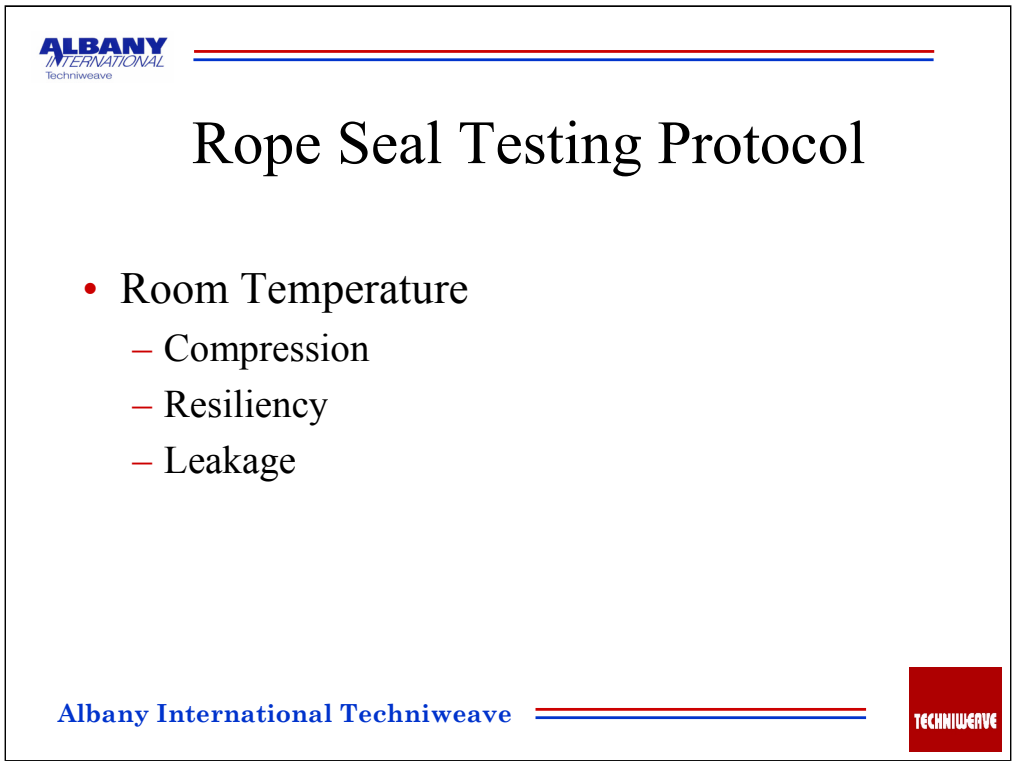

Albany International Techniweave, Inc. (AIT) has been fabricating a wide variety of rope seals since 1990 for NASA and other aerospace companies. Each customer typically tested the seals as they deemed necessary for their individual application. AIT is now developing standardized testing protocols for its family of high temperature seals in order to provide basic engineering data to its customers. Although testing at high temperature would be ideal, the difficulty and cost makes it prohibitive. AIT is developing room temperature data to establish a baseline. It is anticipated that selected tests at high temperature will provide the basis for establishing correlations between the room temperature data and performance at elevated temperatures. Thus we are working on establishing baseline compression, resiliency, and leakage data.

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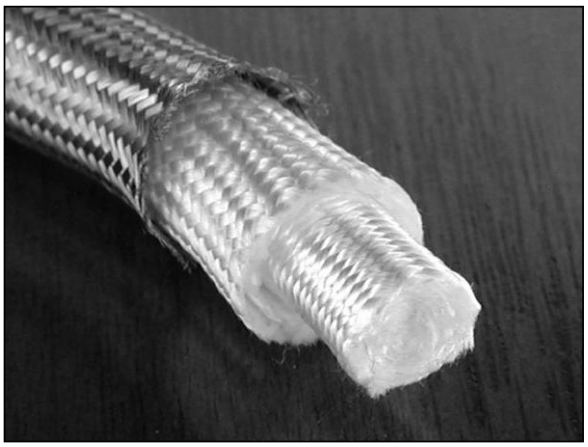
Hybrid Rope Seal



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The “Hybrid” seal is one of most popular seal designs. In this case it incorporates a tightly braided, multi-layered, ceramic core with a heat resistant wire overbraid. The overbraid toughens the seal and minimizes damage both during assembly and in use.

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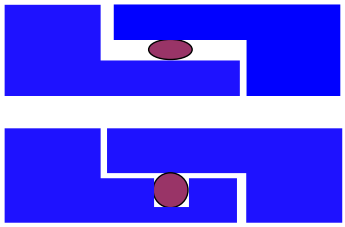
Typical Configurations



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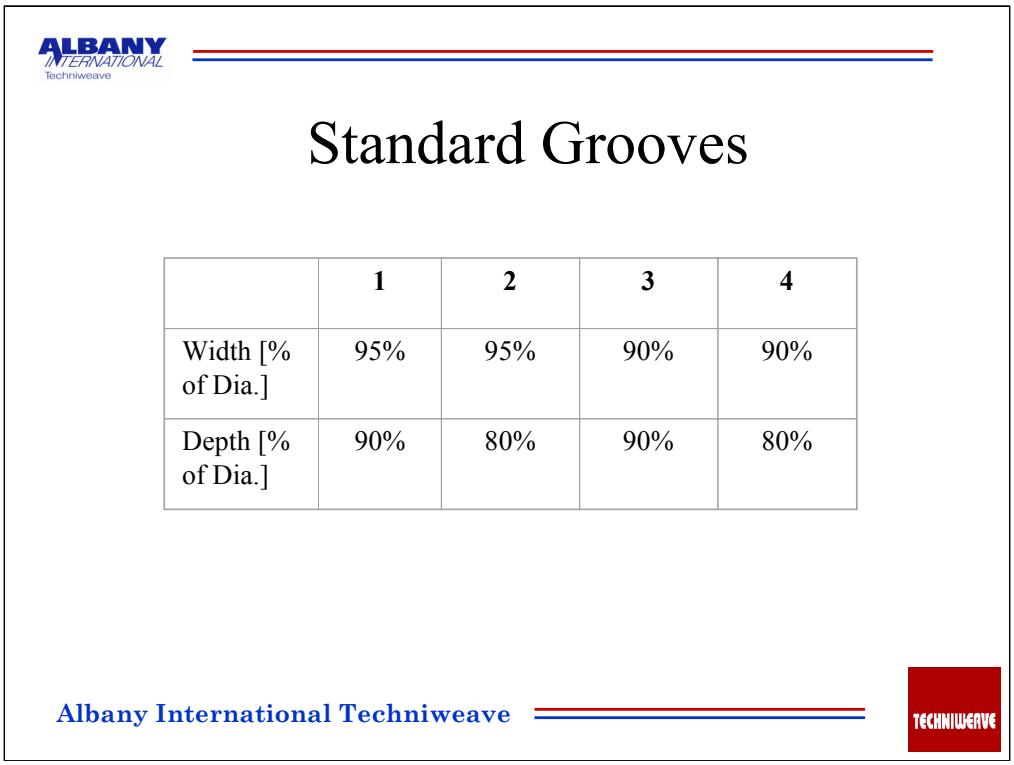
Seals can be used as a barrier between two plates or in a more conventional “O” ring groove as shown above.



Compression tests have been conducted using rectangular grooves. While the dimensions of the groove offer unlimited possibilities, we have elected to test four groove variations for each of our standard seals. We have concentrated on grooves with widths slightly less than the nominal diameter of the seal to ensure the seal would be held in place during assembly. The width and depth dimensions of the grooves for the four test conditions are described as a percentage of the nominal seal diameter. Compression of seals in groves shallower than 80% of the seal diameter exhibited significant distortion and is not considered to be of interest at this time

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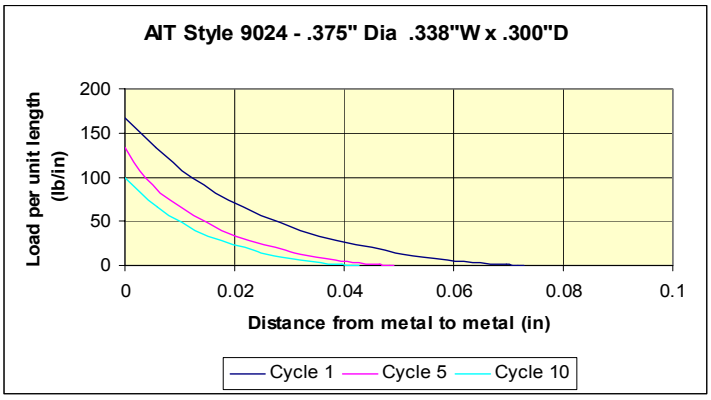
10 Cycle Compression



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. An Instron™ testing machine was used to compress the seal until the top platen made full contact with the grooved plate. The process was repeated 10 times to provide an understanding of the relaxation that might occur. The data has been graphically presented with only the first, fifth, and tenth cycle included.

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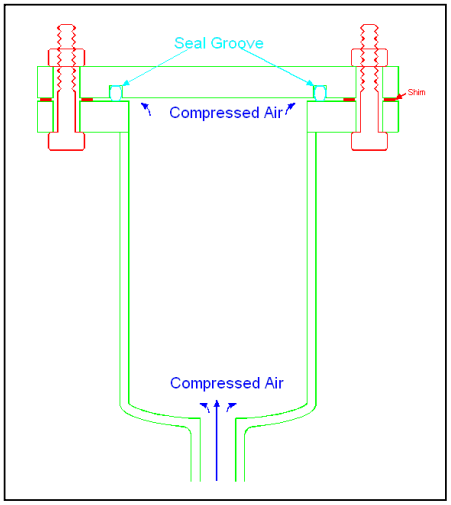
Leakage Testing



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The flange was shimmed away from the flat base plate using shim washers to provide uniform spacing,

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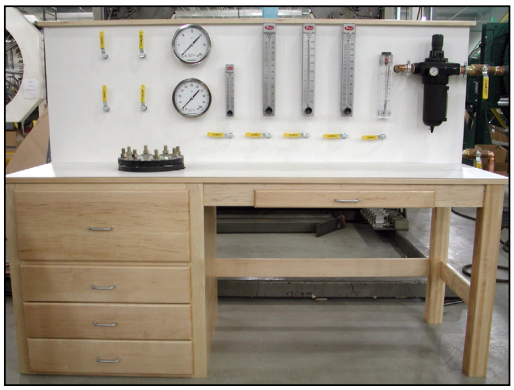
Leakage Test Fixture



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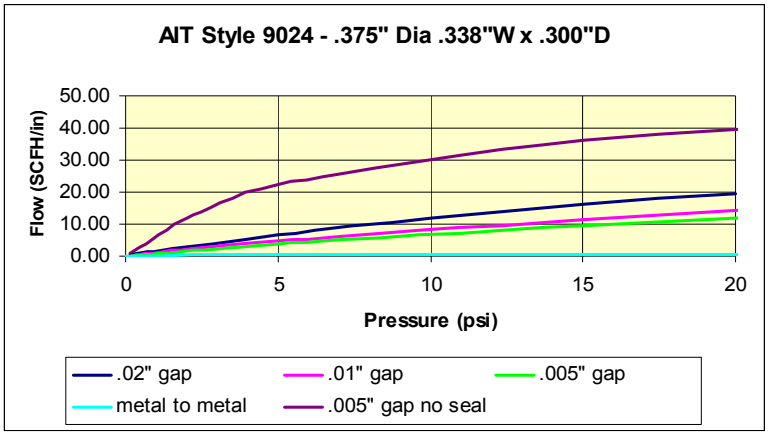
The seals were tested for leakage using the test apparatus pictured below that provides for flows from .20 SCFH to 100 SCFM and pressures from 2 inches of water (.07 x PSIG) to 100 PSIG. All seals were tested with the fiber sizing removed. The grooves were machined into a blank flange with the centerline corresponding to a circumferential length of 18 inches. The grooves have the same configuration as those used in the compression testing. The gas is standard shop compressed air from a rotary screw compressor equipped with a cooler for moisture removal. The butted seal ends were coated with caulking and allowed to dry overnight to eliminate this leakage path. The seals were compressed to a complete metal to metal condition (fully compressed into the groove) ten times using an arbor press to seat the seal and “precondition” it prior to testing.

Typical Leakage Test Data



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The full metal to metal condition represents a condition with no shims, the flanges tightly bolted, and the seal fully compressed. Machining variations provide a minimal leakage path which is impeded by the seal. The flow data has been presented as flow vs. pressure with a separate line for each shim height.

Future Work

- Continued baseline data development
- High temperature testing
- Increase & diversify product line